



# Capnography Monitoring: Yesterday's Luxury, Today's Necessity

**Wong:**

I would like to welcome you to the Health and Safety Podcast. My name is Michael Wong. I am the founder and executive director of the Physician-Patient Alliance for Health and Safety.

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We're talking today about end tidal CO<sub>2</sub> monitoring during conscious sedation and I have with me two distinguished physicians, Dr. Matt Kurrek and Dr Richard Merchant. The two of you coauthored an editorial, "Yesterday's Luxury, Today's Necessity," after the Canadian Anesthesiologists' Society [CAS] published its revised 2012 guidelines to the practice of anesthesia.

For the listeners not familiar with who you are, could you give us a brief background about you? Dr. Kurrek perhaps you'd start?

**Kurrek:**

Yes. I'm a professor of anesthesia at the University of Toronto. I have a particular interest in patient safety and participate, and still participate, as a member on the committee that writes the guidelines at the time when this issue was addressed and Dr. Merchant was the chairman of that committee, and in that capacity we were interested in the role of peri-operative respiratory monitoring.

**Wong:**

Excellent. Dr. Merchant, perhaps you could give us a brief background.

**Merchant:**

Yes.

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Dr. Richard Merchant is my name. I'm a clinical professor of anesthesia at the University of British Columbia. I'm a clinician in the Royal Columbian Hospital, which is a slightly peripheral, but teaching hospital associated with the UBC. At the time we wrote this editorial in 2012, I was chairman of the standards committee of the CSA, a position from which I have subsequently stepped down.

**Wong:**

Tell our listeners what you concluded in your editorial or why you felt the need to write it?

**Merchant:**

The editorial followed up on the changes which were made in what's called the guidelines to the practice of anesthesia. This is a document that was written way back in 1975, and has been actively reviewed and updated by the committee as time went on. And, at that time, a new document was published each year, and we took the opportunity to write an editorial, which emphasized the changes which had taken place in the current year. In 2012, we introduced guidelines for the monitoring of sedated patients in the recovery room and we wanted to bring that to people's attention.

The use of capnography is widespread in operating rooms, where the patients are under general anesthesia or sedation, but it is typically much less used in other areas where patients are sedated- and, particularly, for example, in our milieu, when the PACU patients may go in sedated and not be routinely monitored with capnography to ensure their ventilation is adequate. We had introduced this as a change, making this a strongly recommended practice.

**Wong:**

So, why do you think, as you mentioned capnography monitoring is standard equipment in the OR. Why do you think that it isn't used as much for patients outside the OR, that are sedated?

**Merchant:**

This is an evolutionary thing. It's common for many of the monitors that have been introduced over time. Initially, they're used in the setting of the highest intensity, which would typically be the operating theatre. Then, subsequently as they become more easily available, less expensive, more reliable, they are seen as being useful in other areas. So, capnography has been used in the operating room.

Traditionally again or initially with patients whose airway, windpipes had been instrumented and for whom the anesthesiologist was taking direct responsibility for moving air in and out, and capnography allows an assessment that is taking place in an adequate fashion.

Patients such as that can and subsequently be extubated and taken to the recovery room, but they still remain at risk of respiratory depression, of problems with their breathing and that's related to the various interventions that have happened to them, including sedative drugs and narcotics. It remains a time of risk- not as high a risk potentially as in the operating theatre- but

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certainly a time of risk for respiratory depression and the consequences associated with that. We wished to emphasize that that was so, as have many learned bodies, including the Anesthesia Patient Safety Foundation and the American Society of Anesthesiologists, but, in the Canadian terms, we wished to emphasize that was something which needed to be taken care of and that a judicious monitoring of appropriate patients needed to carry on through into the post-operative care areas.

**Kurrek:**

I can just add onto that?

**Wong:**

Sure go ahead.

**Kurrek:**

I can just add onto that. The way capnography has evolved was primarily based on monitoring in the operating room and you have to recognize that the patient behaves, so to speak, a little bit different in the operating room compared to the recovery room, or after the recovery room and discharged perhaps on the floor. In the operating room, the patient is essentially motionless and often intubated, so that gives a very high quality capnographic monitoring. It means that the capnographic trace and the analysis of the alarm has a very good sensitivity and specificity, resulting in a very good predictive value, when you look at the alarms of these monitors. As a patient may be transferred from the operating room, extubated into the recovery room, even though he may be sedated, and making him still likely to have that adverse respiratory events, he may be a lot more mobile and the anatomy of the airway changes from when he was intubated - so, that brings along certain challenges with respect to capnographic monitoring. But the technology is evolving and some of the sensitivity and specificity, particularly in the later post-operative case, including monitoring on the floor, is yet a matter of ongoing investigations.

**Wong:**

You mentioned sensitivity. We did a survey a few years ago asking clinicians whether they would monitor more. Most of them said that they would monitor more, if alarm fatigue was going to be reduced or whether if the sensitivity, as you put, of the capnograph, would have been increased. So, do you think that would be the case today still?

**Kurrek:**

Alarm fatigue is a fairly serious issue. We all are aware that many clinicians have the tendency, sometimes to actually do it in practice, is to turn off the alarms, particular in high workload situations, because they're overwhelmed with the alarms and some of them may not necessarily add a whole lot to clinical care. If the capnographic alarm is overly sensitive and therefore setting it off may be a result of an architectural movement of the patient, or displacing of the canula, because again in the recovery room and on the floor the patient may not necessarily be intubated. So, for example, the patient shifts in the bed post-operatively from the right to the left side, the monitoring canula that monitors capnographic tracing in that setting, may temporarily

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become displaced, even though the patient is not at risk for respiratory events, it may still alarm, just simply because the canula gets displaced.

So, when that cannot be adequately dealt with, that creates a problem that may overwhelm the clinician, be it physician or nurse, with the number of false positive alarms, resulting in alarm fatigue. As I said, this is evolving and will likely have to be investigated and addressed.

**Merchant:**

And that's quite true, but the point that really must be made there is that alarm fatigue or having false alarms is not a reason not to use devices to ensure that your patients remain safe. The challenge there is to develop either technology or the non-technological solutions to work around that. For example, in Vanderbilt, they did some studies on post-operative capnography on the ward. Our paper referred to PACU, which is a bit of a different setting, but on the ward where they adjusted the alarms and made it so it was more reliable in technique. So, that's an ongoing area of work, but it's not a reason not to use this type of monitoring technology.

**Wong:**

And the other thing, we have from healthcare facilities is just educating the patient. I know you mentioned the patient being more active and obviously some of them find the nasal canula to not be pleasant to wear and so they may take it off, which could create a false alarm and that kind of thing. Healthcare facilities that we deal with, they have said if they tell the patient or the family sort of what's going on and why they're being monitored in such a fashion, usually that tends to decrease the number of false alarms. Do you find that true in your practice?

**Kurrek:**

Yes. Just to go back to what Dr. Merchant also just emphasized that the editorial dealt primarily with an area that traditionally had not been captured in the Canadian guidelines and that is patients whose airway may not have been instrumented, but who are deeply sedated. In those patients, traditionally, you would probably not get a lot of false positive alarms, because they are deeply sedated, they move around a lot less. What you are referring to is primarily a problem on the floor. There are currently ongoing debates on who would be monitored and what optimal monitoring would reflect to. I don't think that there has been a final decision made on that yet.

**Wong:**

Yes, you're right. Most clinicians and their patients think procedures requiring procedural sedation are minor and in a sense risk free. What do you think is the biggest danger in procedural sedation and why would you recommend capnography monitoring for these patients?

**Merchant:**

I'll take that on. The reality since we wrote the editorial is that the use of procedural sedation is increasing. It's increasing progressively and care is being moved out of the expensive critical care hospital bases into other settings less critical in terms of monitoring places. So, in fact the

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complexity of cases is going up that are undergoing procedures under sedation and they are being moved around. I think that's the biggest change. The positive change is that technology is improving. It's becoming simpler. There are a variety of alternatives to just simple CO2 monitoring. There are some monitors which - I wouldn't go into detail - are addressing ventilation rather than carbon dioxide movement and they may provide different advantages and they're cheaper. Cost is no longer a prohibitive block, so there's no reason that places should not consider using them. Typically, when they are introduced into areas, unfortunately it's because there's been a crisis and that's the wrong time to introduce a patient safety tool. Patient safety tools should be introduced prior to there being a crisis.

**Wong:**

Certainly, we have heard of a lot of instances where a hospital has had an adverse event or tragically a death and then they institute continuous monitoring. What you're recommending is try to tackle the problem before an adverse event or sadly a death will occur.

**Kurrek:**

Proactive

**Merchant:**

If I can add on to that. You asked about the risk of sedation or particular procedures, for example, colonoscopies or other types of procedures. Certainly, the difference is in risks in the procedures themselves and the sedation care. I'll just focus on the sedation care, and that risk may be linked to the depth of sedation. We have to recognize that there is reasonable good evidence to support capnographic monitoring, respiratory monitoring, for deep sedated patients. Hence, we wrote that particular editorial. Not surprisingly, evidence for lightly sedated patient is not a very strong. Now there's the whole area, if you give something intravenously, that the patient for whom you intend to give, mild sedation may temporarily pass into a state of deep sedation before the anesthetic distributes in the body and before you end up in the targeted sedation depth - that's a different area. To go back to what you said, I think the risk is probably related to the depth of sedation and includes by and large respiratory complications. So, I think in order to minimize those, the practitioner would be well advised to see what depths of sedation the patient would actually be best served for, given the patient's co-morbidities, the resources, and the particular procedure. In other words, don't unnecessarily over sedate the patient because there are some recent publications out there, that certainly call into question whether deeper levels of sedation may indeed be linked to increasing adverse outcomes and if they are really always needed in the best interest of the patient. If you determine that given the patient co-morbidities, the procedure and the resources that you have available, that this patient would be best served with deeper levels of sedation, then obviously monitoring for respiratory compromise and early intervention would probably be one of the key strategies to minimize the risk to the patient. That would, in my opinion, justify the Canadian guidelines for appropriate respiratory monitoring and, in our case, capnographic monitoring.

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**Wong:**

In the title of your editorial, "Yesterday's Luxury, Today's Necessity," as an attorney, I find that title interesting in the sense that what that title suggests is the change in the standard of care - one where yesterday it might have been considered optional, but today it's considered a necessity. Is that what you guys intended by that title?

**Merchant:**

Yeah, that's correct. I think that it's really in the awareness about sedation causing respiratory problems, it's a relatively new thing. You know, the obstructive sleep apnea question, that term wasn't really used in anesthesia until the turn of the twenty-first century. I think the first incidence of it's use in an anesthetic article wasn't until in 2002 and now everybody has obstructive sleep apnea. So, before that, there were instances of patients suffering complications on the ward or actually even in the OR a little bit before that, that's another story, or in the recovery room and people just thought it was bad luck, but it's become more and more clear that these are predictable side effects of drugs and this is why the Anesthesia Patient Safety Foundation took this on as an effort back around in 2006, 7 or 8 and has published several articles in their newsletter about capnographic monitoring. So, that's why perhaps that term was that it was a luxury back at the beginning of this century. But, now these events are absolutely predictable.

The evidence is completely there that it's this type of event will happen and it's predictable in a certain volume. I can't quote you those numbers off the top of my head, but that's why for clinicians, one of our primary goals is the safety of the patient and quality the patient care becomes the thing which we say that we must have, not necessarily because the courts say we must have it. When you bring up the judiciary, we're not talking about judiciary, we're talking about giving safe patient care. So, for us as clinicians, it becomes a necessity that we have to push our administrations to purchase these devices and to use the devices.

**Wong:**

Certainly, I think in medical standards of care, it should be physicians and clinicians that decide what the standards should be and shouldn't be for some judge and jury, who probably have had no medical training at all, to decide what the standard of care is. Your article referred to the Canadian Medical Protective Association reminding its members that there is a possible lag between a clinical practice guideline is published and the time that it is accepted into clinical practice. Do you think that that that gap has closed in the five years since you wrote the article?

**Merchant:**

I would have thought so - certainly in my own recovery room. Most of us I guess we don't have experience with knowing what happens everywhere, but in my own recovery room, capnographic monitoring has become much more common and in certainly in the OSA population that are referred to. We could also should probably also emphasize that our guidelines are not rules, they are there are standards established by a peer group of clinicians advising what you're likely best to consider doing and, in my hospital, that is happening. Patients

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who are who on a ventilator in the PACU, a few years back, they didn't necessarily have CO2 monitoring but today that's the routine. We're suggesting that needs to go beyond ventilator to patients who are at risk respiratory depression, for whatever reason, including obstructive sleep apnea, history, and that sort of thing and in fact it's happening. It is a small expense considering what the potential is.

**Kurrek:**

If I can add on to that. I also wear that hat of a regulator, in a sense that I inspect some of the premises, particularly off site anesthesia. And, I can tell you from my experiences - these data are not published - there still seems to be a considerable lag between the time of that editorial and the guidelines to monitor capnographically the respiratory status of the patient when deeply sedated. And I'm talking just about the operative aspect, I'm not talking about recovery room. And, there are probably two components to it or several components. One facet is the fact that things lag behind in a hospital, because that does require purchase of additional hardware and sometimes if you apply within the hospital to purchase additional hardware that administration process to go through and that can take several years. So, we have not infrequently, hospitals who are still in the process of upgrading their capital equipment in some of the offsite locations, for example in gastroenterology suites, where traditionally that modern equipment was not available. The second reason is that it's probably also a gradient between the location type or the hospital, so some of the changes may happen that rapidly in larger academic centers, and may thin out as far as the speed of implementation goes into the periphery. And the third factor is that it depends also on who's actually responsible for the sedation, because the guidelines we have to recognize are written by anesthesiologists and published in an anesthesiology journal. So, they are not necessarily abided by non-anesthesiology physicians. So, physicians in the emergency room, ICU physicians or gastroenterologists, who are providing sedations, even in the hospital, may not necessarily use this capnographic monitoring.

**Wong:**

Ideally all patients receiving sedatives should be monitored but there are obviously some that receive a heavy sedation or as you mentioned or OSA patients. Are there others that you would highly recommend be monitored?

**Merchant:**

Like I said, for the procedure, it really depends on the level of sedation, so we did not indicate that every sedated patient should be monitored. We reviewed the literature at the time of writing this editorial and, as written in the editorial, there is reasonably good evidence to support to use a capnographic monitoring for deeper levels of sedation. For minimal levels of sedation, there's not surprisingly relatively little evidence - patients pretty much awake but relaxed the whole time - there's probably no evidence that the use of capnographic monitoring decreased the incidence of adverse respiratory events. But, for deeper levels sedation, there certainly is. So, that's the key aspect of. It probably doesn't depend on who does the procedure, where you do the procedure, it just depends obviously the patient's risk factors but then the level of sedation.

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**Kurrek:**

So if you can talk to your patient, they are probably not suffering from respiratory depression. So, that's probably safe enough. One of the little risks of that, of course, is that once you stop stimulating your patient, can they then lapse into a deeper state of sedation, because it's a balance between sedative medications and stimulus. So, I can visualize a scenario potentially in the emergency department where somebody having their fractured wrist repaired.. So, when you're in the middle of having broken bones manipulated it's very stimulating you're going to be awake. If it's not very stimulating - if their manipulating your broken bones and actually you're probably under general anaesthetic and not sedation - but if you're awake and talking to patients and then everything's settled down, the clinician needs to be aware that this is a time when patient continues to need monitoring. Drugs don't go away instantly and other effects can do, so again the technology is a supplement to good, thoughtful careful clinical practice.

**Wong:**

Excellent thank you so much. Any last words you'd have for clinicians who are maybe tackling the obstacle of purchasing equipment and why they need to monitor their patients particularly those under deeper sedation?

**Kurrek:**

With respect to purchasing equipment or general practice?

**Wong:**

Purchasing equipment obviously seems to be - what we've found in speaking with clinicians seems to be - a big hurdle. Any words of advice that you would give to folks, if they want to implement continuous monitoring in their facilities?

**Merchant:**

The equipment is not very expensive, not compared to many, many pieces of equipment that are used in hospital these days. The advice is to use materials, such as our standards of practice, which say that peer clinicians advise very strongly that this equipment be available for this use. The APSF literature is very strong on that and the ASA literature similarly. So, use those tools and keep pressing. None of these things can be done instantly. No administrator, in my experience, you walk up to and says we need to buy this, and he says sure. But the clever administrator say I do have lots of money, I just need help to choose where to spend it and to make a case that this is a very useful place to spend it.

**Kurrek:**

Even with the technology, if you look at the article, the incidence of respiratory complication was never a zero, so by implementing technology you certainly don't eliminate the risk of respiratory adverse events. So, my key message to clinicians, even when implementing this technology, do not be lulled into a false sense of safety and security, or sometimes thinking that you have the technology, you are invincible. You may actually be more liberal in the administration of

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sedatives. You may be easier to be distracted, because you think capnographic monitoring is taking over that the vigilance. So, always be very mindful and use it as an added level of safety, but not as a substitute to good clinical judgment and vigilant care.

**Wong:**

Well thank you so much both of you for joining me on this discussion of end tidal CO2 capnography monitoring. It sounds like part of issue could be the awareness of the need for monitoring particularly of patients undergoing deep deeper sedation and the need for monitoring those cases.

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